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ABSTRACT

This paper describes a series of longitudinal experiments which dealt with the development of object awareness in infants, ages 6-18 months. The experiments were designed to document and evaluate Piaget's account of this development. The studies focused on two types of phenomena: (1) when infants first find an object hidden in one place, they will search at that place even when the object has been hidden at a second place; and (2) in terms of a system of levels, infants' responses to seeing one object disappear, and finding another in its place. Examination of the two types of phenomena generally supported Piaget's notion of an intermediate level of object awareness, one where infants sense a definite but diffuse connection between successive appearances of objects in time and space. The need for clarification of Piaget's hypothesis concerning the nature of object awareness during this period is noted. (ED)

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# On Levels of Awareness of Objects in Infants and Students Thereof*

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Abstract

A series of studies of 6 to 18 month old infants is presented. They are addressed to documenting and evaluating Piaget's account of the development of levels of object awareness. The studies were focussed on two types of phenomena. One marks for Piaget the emergence of the beginnings of a sense of object permanence, a level intermediate between awareness of objects as "pictures" and awareness of objects as such. The purported phenomenon is that when infants first find an object hidden in one place, they will search at that place when the object is then hidden at a second place. The second set of phenomena involved looking at, in terms of a system of levels, infants' responses to seeing one object disappear and finding a different one. Examination of the two types of phenomena generally supported Piaget's notion that there is an intermediate level of object awareness, one where infants sense a definite but diffuse connection between successive appearances of objects in time and space. However Piaget's hypotheses about the particular nature of object awareness in that intermediate period and the meaning and role of action need to be clarified. A call is made for simultaneously pursuing a search for descriptions of levels of mindedness and descriptions of the levels of stimulus information such minds are attuned to.

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# ON LEVELS OF AWARENESS OF OBJECTS IN INFANTS AND STUDENTS THEREOF

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A wise friend provided a point of departure for this talk about the studies my students and I have conducted on infants and Piaget's object concept notion. He reacted to my struggling to tell him what we have been about by saying, "Oh, it's like the situation of the British anthropologists of the early 20th century." In other words, we have been on a long trip into the jungle, have seen many interesting things, and now have to find a way of giving common meaning to the exotica we have experienced. My pretentious title signifies my struggle for meaning. It would be appropriate for a paper I discovered I was not ready to write. Instead, I'll primarily dwell on the two types of phenomena that I have worked with in terms of a notion of levels. You will find me sometimes using levels in a Piagetian sense, levels of mindedness; sometimes you'll find me using levels like the Gibson's (1966, 1969), levels of information in the stimulus array. However, I'll leave it to you, or to others, to reflect on the nature and virtue of a notion of levels. I primarily will try to convince you that the phenomena we have been working with are interesting.

I started off on my trek almost 15 years ago. It was an exciting time. The importance of infancy was being trumpeted on every side, headlined by such phrases as "imprinting," "early experience," "critical periods." The principal things to be discovered in the "far-off-land" seemed to be the origins of social feeling and thinking, those distinctive characteristics that make us human. I, like Burton White in his address to this conference a number of years ago (1969), felt that Piaget's account of infancy, particularly his story of the development of the object concept, was the best available "ethnography" to build upon. Most simply put, Piaget seemed to

say that one cannot love others or think about them unless one knows them as distinctive permanent objects. One cannot relate objects to one another spatially, temporally, or causally unless one has a sense of an object. To quote Piaget, "As Mr. Brunschvig says, 'to conceive of space consists first of all in furnishing it.'" (1954, p. 183).

The Piaget (1951, 1952, 1954) of the infancy books appealed to me. He made infants very real. A given observation enabled me to see a detailed relation between the infants' acts and the situations in which they were acting. I often felt as if I could literally re-enact the infants' attempts to make sense of the situations and thereby know their experience. The observations took in a broad compass of settings and issues of adaptation. Further, he brought a sense of proportion to the period of infancy. Perhaps it was my fault--I don't really think so-- but I sensed something magical about the banners of that time. They seemed to say that an answer to some large question of adult life was contained either in infantile experience or in the congenital make-up of infants. Piaget took a much more modest stand. Each period of life has its function. Like such American pragmatists as John Dewey and George Herbert Mead, Piaget has a view of development in which each period results in an achievement that sets the stage for re-achieving the goal in a larger context, the idea of vertical decalage. Like Dewey and Mead, he rejected both empiricism and nativism and yet tried to use the wisdom of both. Before there can be experience, there must be an idea in some sense. But the idea is small, a limited one. In growing up, one does more than concretize the pre-formed competence, one enlarges and transforms the idea. While identifying and giving clear meaning to the periods of life is easier said than done, the endeavor promised order and sense to me.

One way of looking at Piaget's (1954) approach to formulating the key achievement of infancy, the attainment of the object notion, is to focus on

three age-graded observations Piaget made. Two of the observations have been commonly made. The third one is a relatively uncommon one to which Piaget attributed great importance and was my own starting point.

The first common observation is the "out-of-sight, out-of-mindedness" of the 6 month old. The observation is interesting because such babes can sit up and reach for what they see more or less well. Even more to the point, if they see a desirable object that is partially obscured by a cloth, they can remove the cloth and gain the object. Yet despite their apparent possession of all the requisite skills, they will not retrieve the object if it is completely covered by the cloth. Piaget's analysis of this event is quite radical. He chooses to believe that it indicates that infants at this and earlier ages are not aware of objects. If they were aware of objects, then they would perceive them as "disappearables" and would have no trouble removing them from under the cover. What they do perceive are "pictures." They can recognize and follow forms, but only when they are in view. Such infants only <u>appear</u> to anticipate the reappearance of an object that moves behind a screen; they only <u>appear</u> to relocate the position of an object they previously turned away from. What joins the successive moments of an object are the infants recurrent actions. The infants have no basis for knowing whether they have observed the same object over time or simply many different but similar objects--they live in a world of sensed similarities, not in a world in which things remain identical to themselves.

The second common observations have to do with pretending, deferred-imitation, and search for objects which cannot be located at their place of disappearance. To treat a present-thing as different than it is, to re-enact a non-present event, to imagine possible locations, these indicate that the child is re-presenting, is unequivocally thinking about an object or event. Such clear signs of object knowledge appear in the second year of life. To

Piaget, they indicate that only then do infants perceive and think of objects, enduring invariant forms which exist independently of the infant. When we observe infants act in such a manner, then we can assume that they know objects much like we adults do. Such knowledge marks the principal intellectual achievement of infancy, the goal of that period of life. The infant has the basis for joining the human community--he can engage in symbolic communication and form mutual attachments.

To this point, I seem to have characterized Piaget as one of many theorists who have argued that infants initially are aware of objects on a sensory level and eventually become aware of them on a symbolic level. The radical aspect of Piaget's position has only been implicit in what I have said until now. Let me make it explicit. While most theorists have identified the problem of early object knowledge in terms of how proximal sensory information is perceived as information about a definite distal form, Piaget made awareness of the object context the chief issue. The problem is how the infant becomes aware that the successive "pictures" are tied together in a spatio-temporal framework. The creation of the framework is responsible for the infant being able both to see objects as such and to symbolize them. Symbolization is not something that follows from the perception of objects. The two events are conjoint.

The third observation serves to further bring out the uniqueness of Piaget's view. The observation, in Piaget's eyes, indexes an intermediate level of development. It shows the infant begin to work on the problem of locating "pictures" in an "objective" context and the observation indicates the mechanism for this achievement.

The observation is a relatively uncommon one. Piaget was fascinated by the fact that when his own three infants were first able to uncover an object hidden within their view they then would search at that first location when the

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object was subsequently hidden in plain view at a second location. Piaget could have interpreted their initial success as the critical phenomenon. He could, like Hunter (1913) and others, have assumed that the infants were able to symbolize, were able to guide their search in the absence of the object by some kind of image of the object. He could have dismissed the subsequent error by assuming that the infants simply had trouble keeping places in a limited memory store.

He chose not to reason in this way. Instead, he saw the observation as strongly supporting his hypothesis that the infant constructs a notion of object through action. In his view, the observation indexed the first sign in the infant of a sense of object permanence, a level that was no longer "pictorial" but was not yet "objective." The infant committed the error because he interpreted the object egocentrically, "a reality at disposal in a certain context, itself related to a certain action." (Piaget, 1954, p. 65). The egocentricity of this level, stage 4, in Piaget's six stages, is a distinct advance over the egocentricity of stage 3.

The stage 3 infant is unable to unconfound act from thing. Insofar as he follows or grasps a disappearing object, it is only because he extends the act of following or reaching. If the act is interrupted, the infant repeats the act or loses all sense of the absent object. The stage 4 infant has some sense of the object independent of the act. He attends to the obstacle of the cover without losing track of the object sought. But he as yet has no clear sense of the object as a "disappearable," as an object which is imaged when out of view. Rather, the screen is an index of the object. "...the screen is perceived as related to the subject and not as related to the object..." (Piaget, 1954, p. 192). In other words, the infant senses that an act on the screen will produce the object. The successful retrieval of the object leads the infant to perceive it as the object of that particular place, and therefore, when

he sees it disappear at a second place, he codes the event as a disappearance of the object-of-the-first-place and searches there.

Thus, Piaget interprets the error as indicating a level of mindedness in which the infant has a sense of enduring, "permanent," objects relative to his actions. The objects have no individual identity. They are not known as independent entities locatable at many possible places, but rather the object exists as multiple similar entities. Piaget hypothesized that he was known at that time as "daddy-of-the-window," daddy-of-the-study," etc. (Piaget, 1954, p. 63).

I now more or less have brought you to the place where I was when I began my investigation of infants. I wasn't too clear what an object concept was or what action was nor how the two were related. But I was clear that Piaget thought that something very special was indexed by the developmental concordance of the ability to uncover a hidden object at one place and search at that place when the object was subsequently hidden at a second place, what from now on I'll call the $A\overline{B}$ error. If Piaget was right, therein lay the origins of object knowledge. I could ignore babies less than six months of age and study the $A\overline{B}$ phenomenon.

Further, I sensed that the virtue of Piaget's stage claims lay not in the discovery of age-graded sequences of performance but in the discovery of counter-intuitive intermediate steps in the sequence. Piaget invariably identifies three stages. There is a preliminary, a preconceptual, phase in which the child acts on but has no sense of the problem. There is a final phase in which the solution to the problem usually is immediately obvious, e.g., "perception" of the conservation of 1-1 correspondence. The intermediate phase marks the beginning of a sense of what is the problem. But there is always something counter-intuitive that the seemingly smart intermediate child does that reveals that he is only into the problem. Such a child does not really understand the problem, and his errors give indications of the processes which underlie the

course of development.

The $A\overline{B}$ error was counter-intuitive. It occurred when the baby first succeeded at A, and Piaget described the baby as alertly watching the disappearances at A and B. The baby's manual act of finding the toy at A was supposed to determine its nature and location, the phenomenon was supposed to reveal the critical role of action in the construction of the concept of object.

My search of the literature revealed that only Piaget had claimed to have made this developmental observation. My path was clear. I would attempt to confirm Piaget's observation. If I was successful, then I would attempt to confirm his explanation of the phenomenon.

I decided to do a short-term longitudinal study in which I would begin at a point where the infants could not find an object hidden under a cover and would stop when they could easily find it wherever they saw it disappear. A student, Bill Landers, and I set up a series of tasks. We would first test to see if the babe could find the toy at A. If he could find it twice in a row at A, we would hide it at B. If he could find it twice in a row at B, we would then hide it more or less randomly at A or B 10 times to see if the babe could find it wherever it disappeared. When the infant could do all these things in two successive sessions, we'd stop. If the infant failed to find the toy at A then we would follow Piaget and first partially hide the toy and then hide the toy completely just before the infant grasped it. We eventually studied 13 infants every two weeks. Typically, we started when the infants were about 6 months of age and stopped when they were about 11 months of age.

The upshot of this study (Gratch & Landers, 1971) was that we confirmed Piaget's $A\overline{B}$ observation and made a number of discoveries of our own which were relevant to Piaget's theme. In the first sessions, the infants would fail to find the object hidden at A and then would pull the partially-hidden object out-from-under the cover. We then went on to the task of covering the toy while

the infant was reaching for it. However, sometimes we were slow and dropped the cover only after the infant had grasped it. The infants did not remove the cover. "A toy in hand did not seem to equal even one in the bush." That seemed worth pursuing and we changed our procedure so that we consistently dropped the cloth only after the infant grasped the toy. We continued to discover that they would retrieve the object if they saw a portion of it but would not retrieve it if they had it in hand but their hand and the toy was covered.

I note, as an aside, that in a subsequent study (Gratch, 1972), I documented that the covering as such was not responsible for this phenomenon. When the cover was transparent, 6 month old infants would retrieve the toy. When the cover was opaque, they were far less likely to do so.

Thus from the very outset of our attempt to follow Piaget, we seemed to be finding evidence that infants who had relatively well-developed abilities to reach and grasp for what they saw and who could deal with obstacles did not seem to be able to cope with an object once it disappeared from view. Having the object in hand, while certainly providing the infants with some kind of information, did not appear to be providing information about objects as such. There was nothing about the touched object that implied its "see-ableness" and there was nothing about the disappearance of the object from sight which implied its "touchableness" or "seeableness."

To give you some sense of the time course of some of the phenomenon found in our longitudinal study, I shall now describe the median age at which certain events first appeared. Almost all infants found the partially-covered object in the very first session, 6 months, 20 days (6-20). Infants then found the object when it was covered after they grasped it (7-18). Then, they made the $A\overline{B}$ error (8-02). Later, they would take both sides into account when the object was hidden at B. They would either look at both B and A when the object was out of sight or they would touch one cover and then pull off the other cover (8-15).

Still later, they would search directly at B (9-08).

The $A\overline{B}$ error occurred often in a session and occurred in many sessions. The infants only gradually learned to take the B side into account. When, in the early sessions, they made the $A\overline{B}$ error, they would not try to correct themselves by searching at B. When they first successfully searched at B, hiding the toy at A would then lead them to search at B. They were learning a new special place, as opposed to learning to search where the toy disappears.

At this point in the talk, I showed the audience video-taped examples of infants who alertly watched the toy disappear at B, stared at the B cover momentarily, and then turned to the A cover, watched it, and took it off as soon as it was within reach. The reader, and I, are at a disadvantage at this point because this concretization of the $A\overline{B}$ phenomenon and the circumstances surrounding it are important to the general theme of this paper, the manifest "reality" of the phenomenon I report on. You have to take my word for it. Babies often make the mistake in such a manner. Moreover, there are two points I would like to make about the circumstances surrounding it. One is so obvious that you may think me simplistic for making it. When the toy is hidden, the examiner must be sure that the infant is attending to it and its disappearance. I make the point because only under such circumstances can one feel that the infant who fails to search or who searches in the wrong place does so because he may understand objects in a different way than we do. While I do not know how often infant researchers deal with the infants they study, Fletcher (1965) has amply documented that a long-line of infra-human primate researchers failed to keep this elementary idea in mind. The second point is that when one has the infants' "eye on the ball" of the particular game, then a host of potentially distracting events can occur which do not interfere with the game. The video-tapes showed us talking to the mothers, to the babies, to people behind partitions, all without distracting the infants from their task. This

is not to say that infants will not be distracted. For example, like Charlotte Buhler (1930), we found that the examiner could talk back and forth with observers sitting behind a partition when we worked with 9 month olds, but 12 month olds were very likely to be concerned about those distant voices. Rather the point I am trying to make is that one need not be overly concerned with strict, standardized procedures. The key issue is not standardization, but methods that are sensitive to whether the infant is in fact doing what he is being asked to do. In any case, Landers and I confirmed Piaget's observation of the $A\overline{B}$ error.

Given the existence of the $A\overline{B}$ phenomenon, my students and I set off to evaluate Piaget's explanation of it. It was a painful process because we did not feel we understood what he was claiming. We understood some explanations he rejected and we understood some particularities of his explanation. These became our focus.

Piaget claimed that the phenomenon was not a matter of forgetting but rather had to do with the failure of the infant to register the information that the object had disappeared at B. If forgetting explains the error, then its likelihood should vary directly with the length of time the object is out of sight. We might not be able to show Piaget was right, but he did give us the possibility of showing he was wrong, a decided virtue in so grand a theorist. We studied 9 month olds. The toy was placed in the well and covered and then the infants waited either 0, 1, 3, or 7 seconds before the tray was slid within their reach. Different groups were exposed to each of the delay conditions. They did not differ in their ability to find the toy when it was hidden at A. Table 1 shows what happened when the toy was hidden at B.

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Insert Table 1 about here

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Two things are very clear. The 0-second group did not err. As you can see, 11 of 12 infants had a 0-run score, indicating that they searched at B on the first B-trial. Second, the great majority of the infants in the 1, 3, and 7 second conditions searched at A on at least the first-B trial. The pattern of results both provides support for Piaget's claim and doesn't. The support comes from the fact that a seven second period, which is really quite long, as well as a 3 and 1 second period were equally likely to lead to error. Further, patterns of attention and gazing during the delay periods conformed with Piaget's notion. Younger infants were likely to both err and to look at A almost as soon as the object disappeared, holding that orientation during the delay period. Older infants were less likely to show such a gazing pattern and were likely to err only when they were somewhat inattentive during the delay period. Thus, the younger infants seemed to be erring because they failed to make sense of the disappearance of the object at B.

Piaget's theory also predicts that the 0-second infants should err. We initially thought that the failure to err might be an artifact of our hiding procedure. We induced reaching toward the place where the toy was being hidden. We thought such reaching plus the sliding tray might freeze the babes on the B side. However, changing the procedure by restraining the reach and not sliding the tray did not lead 0-second infants to err. On balance, we don't think this result invalidates Piaget's hypothesis. We find it easier to believe that success in the 0-second condition is based on a stage 3 level process, an extension of the visual and bodily point that is set in motion by the hiding. We don't want to push the interpretation but do note that Harris also has pursued the forgetting hypothesis. In his first study (1973), he believed he showed Piaget was in error. In a subsequent study (in press), he has come to believe in the merit of the idea that infants of this age are perceiving the displacements of objects in a way very different than we adults do.

Piaget's account of the $A\overline{B}$ error places great stress on the action of manually finding the toy at A. He has repeatedly emphasized that this manual act determines the infant's failure to register the hiding at B. Landers (1971) took up this point by attempting to compare active search at A with observation of toy disappearance and reappearance at A. His study of 9-month old infants is inconclusive primarily because his observer group also actively searched at A on some of the trials.

Evans (1974) took up the same question in a more direct fashion. He compared 4 groups. Two actively searched at A, one twice, the other 5 times. The others watched the toy disappear and reappear at A either 2 or 5 times. The number of Ss who erred in each group was approximately the same. Thus Piaget's emphasis on the role of active search seems misplaced. The key event that seems to determine the error is the observation of the disappearance and reappearance of an object at A. Again, we don't think this invalidates Piaget's central thesis, but we think it calls for a greater emphasis on the role of the stimulus displays the infant sees than Piaget provides. I'll return to this point at the end of the talk.

As I have tried to indicate, these studies were very "stimulus bound," Piaget's observations and arguments dominated our efforts. We gradually began to "de-center." We gradually began to wonder more and more about what kind of object was leading our infants to be so spatially disoriented.

Appel (1971) did the first of these studies. He wondered whether the searches we observed had anything to do with an object being hidden. In other words, he got to thinking on a decidedly non-Piagetian line. He reasoned that infants must come to our situation with a long history of discovering that if you pull on a cover you might find something interesting underneath it. He decided to see what would happen if he hid "no toy." One group of 9 month olds saw a toy hidden in a box which then was pushed in front of them. Another group saw "no toy" hidden. Half saw a covered box. He rapped on the front

of it and pushed it toward them. The others saw him "hide" his empty hand and withdraw it. Appel was wrong. The "no toy" groups did not search on 5 trials and the toy group searched on all 5 trials. Our babies searched only when a toy was hidden. But then he reversed the conditions. The no toy-toy infants searched. But 8 of 12 toy-no toy infants attentively watched "no toy" hidden and then searched. If babies search for the disappearing toy, we should not have found that result. The $A\bar{B}$ phenomenon might be the same kind of event. Before examining this question, Appel observed 12 month olds. The results were quite different. 12 month olds searched only when the toy was hidden and did not search when "no toy" was hidden; they really seemed to have their "eye on the ball."

Appel then extended the study to the 2-position case. Nine and 12 month old infants saw a toy hidden at A 5 times. All found it. Then half saw a toy hidden at B. Half simply saw Appel rap on the front of the covered B well.

The study produced a mixture of clear and peculiar things. The 9 month olds who saw a toy hidden at A were far more likely to search at A than were 9 month olds who did not see a toy hidden at A. Thus hiding a toy at B was important in the $A\bar{B}$ error, the activity of hiding a toy at B was more than a diffuse signal to the infant to pull the A cover. Further 12 month olds who saw a toy hidden at B searched at B. So much for clarity because the 12 month old "no toy" infants searched, as did the 9 month olds, sometimes at A, sometimes at B, sometimes at A and B. They did not refuse to search. The seemingly simple complication of introducing two places made the 12 month olds less than "clear-eyed." While the result is very generally consistent with Piaget's account and a recent study by Harris (in press) of children in this age range, we are less than clear why the 12 month old no toy infants searched and why the 9 month olds were far less likely to search at A simply because "no toy" was hidden.

We did not pursue those interesting leads. Instead we did another study keyed to an aspect of Piaget's reasoning. Piaget seems to argue that finding a toy at A marks it as the toy of that place. Evans and I (1972) reasoned that if we hid a discriminably different toy at B, it would not be seen as the toy of the A-place and the infants would not be likely to err. Alternatively, if hiding the same or a different toy at B are equally likely to lead to the $A\overline{B}$ error then one would have to conclude that the error had to do with spatial difficulties rather than object-conceptual difficulties as such. The result of this investigation of 9 month olds was that infants were equally likely to err under the 2 conditions even though the infants in the different toy condition appeared to definitely notice that a new toy was hidden at B.

While this result seems to indicate that the infants are having difficulties with spatial locations rather than with the problem of knowing that one-and-only-one toy is being moved from place to place, the issue is unresolved. We have seen infants who uncovered the toy at B then remove the cover at A. Certainly in their case, they searched where the toy disappeared but did not seem to appreciate that they were dealing with only one toy. Moore (1973) has been actively pursuing this issue, claiming that the $A\overline{B}$ error is indeed a result of a failure to understand the identity of objects. We eagerly await a full reporting of his findings.

At this point, I hope I have convinced you that the $A\overline{B}$ phenomenon is a real developmental event and that study of how infants keep track of objects in space must be an integral part of any investigation of the development of object awareness. I don't think the investigations I have reported on clearly confirm or deny Piaget's ideas about the lack of awareness of object identity in 9 month olds or the role of action in the development of object notions. I am now ready to consider the second type of phenomenon we have been working with. Off of our work, my students and I decided to approach the question of levels by another route. We chose to examine the kind of relation infants perceive between the

the specific object that disappears and the specific object that reappears, an issue that Piaget never attacked in a concerted manner. LeCompte and I (1972) di this in a simple, direct fashion. We observed the reaction of 9, 12, and 18 month old infants to repeated cycles of the following situation. On three occassions, a toy was hidden in a box and the infants found it. Then the toy was hidden, but the infants found a grossly different toy. We assumed that the ages chosen corresponded roughly to Piaget's stages 4, 5, and 6. We developed a way of thinking about this little world which we used to code what happened.

We reasoned that an adult sees the disappearance of a toy into a box and the subsequent reappearance of the toy in the box as a single event. The adult has the idea that what goes into the box will remain there in the same form. The disappearance of the object sets in motion the subsequent phases of that unitary expectation. Therefore when the adult uncovers the well and sees a different object, he'll be surprised, i.e., he will react suddenly and intensely to the missing step in the invariant sequence of events. He'll then react to the new object by wondering where the other one is and what accounts for the appearance of the unexpected object. He may search for the missing object, ask the experimenter what he did, search the box for a false bottom, etc.

Given Piaget's characterization of stage 6, we felt that such infants would react much like the adults I have described. Further, Piaget's theory also indicates that there should be two other gross, and lower, levels of reaction to the trick. The second level should be one in which the infant is not aware of a unitary disappearance-reappearance sequence. The child should only have a contingent sense of the two events, they usually belong together, and no sense of why they are united. Such a child should not be surprised. He should slowly become puzzled as he assimilates the fact that the new toy is different than the one he was set to see. Further, because he has no basis for imaging

the missing object, he should not search for the missing one but instead should focus confusedly on the new toy. In other words, these were the kinds of reactions we expected from infants Piaget would characterize as being in stage 4 or 5. We visualized the third and lowest level as one in which the child would have an appreciation that the two "pictures" were different but no sense that they had to belong together. Such infants should attend to the new object as a novel event. They should stare at the toy prolongedly, examine it, but not be distressed by its presence.

Given these hypotheses, we constructed two scales. One, the puzzlement scale, (see Table 2), is an attempt to describe the infants' initial reaction

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Insert Table 2 about here

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to the sight and perhaps touch of the toy. It consists of 6 categories. 6 is surprise, 5 is definite puzzlement, 4 is mild puzzlement. Categories 6 through 4 all imply that the infant has some sense that a violation of the connection between the toy that disappeared and the toy that reappeared has occurred. 3 is definite noticing, the novel reaction I described earlier. 2 is recognition, a short definite look at the object, and 1 is an automatic look, a quick casual glance at the toy. Category 3 implies a sense of change of object but no sense of violation, and the other two categories imply no sense of change.

The instrumental scale (see Table 3) describes what the babies then went on to do about the toy in front of them. It has 8 categories, only 6 of which are relevant to our purpose. 6 involves a questioning focus on both the experimenter and the missing toy, as if the infant were looking for a cause. 5 involves a focus on the missing toy. Both 5 and 6 directly imply some form of representation of the missing toy. 4 is a transitional category, the infant neither accepts nor rejects the toy in the box, implying the infant is troubled

but has no sense of the missing toy. 3 refers to examination of the toy, 2 is appropriate use of the toy, and 1 is stereotyped play with it.

Once again, I used video-taped incidents to concretize the phenomena embodied in these scales, and we cannot share that medium here. But I would like to point out several things about the scales. One, which I am sure you have sensed from reading the scales and imagining what you or a baby might do when tricked, is that the judgements are not easy to make. They demand that you identify a particular pattern amidst many on-going events. However, certain aspects of the scales are fairly clear. While distinctions between surprise, definite puzzlement, and mild puzzlement may be hard to make, one can readily distinguish between a frown and non-puzzled looks such as a stare or a glance. Secondly, it is easy to discriminate between an infant who ignores the toy in the box and searches in and around it and an infant who focuses confusedly on the toy in the box and an infant who takes the toy and inspects it systematically or simply plays with it. The phenomena are not hard to find if one looks for them.

Figure 1 presents, in graphic form, the general result that we found in the study. It presents, on the ordinate, the puzzlement scores, our judgements

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Insert Figure 1 about here

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of the children's initial reactions. On the abscissa you can see that the infants on the non-trick trials--trials 1,2,3,5,6,7, and 9-- tended to get scores of 2 and 3, i.e., they tended to stare, briefly or at length, at the toy. However on trials 4 and 8, the trick trials, infants of all ages reacted differently. The mean score for the 18 month olds was about 5 on the first trick and the score for the 9 and 12 month olds was about 3.5. Comparable trends were present on the second trick, with the 12 month olds scoring higher than they

did before. We had expected that the infants, at least the older ones, would be distressed on the trials after the trick, perhaps even being puzzled over not being tricked again. While a few infants did react to the trick on the subsequent non-trick trials, Figure 1 indicates that most quickly acted as if the trick had never occurred. The trends for the instrumental reactions paralleled those of the puzzlement reactions. I'll not report them because I would only be presenting more means, and a better way to indicate how the results of this study conformed to Piaget's description of levels is to talk about individuals. Ten of 12 18 month olds, on at least one of the two trick trials, reacted with surprise or deep puzzlement, scores of 6 or 5, and then searched for a cause or the missing toy, scores or 6 or 5. Nine month olds also acted as if they had a notion of the connectedness of the disappearing and reappearing toy but their sense of the connection seemed more diffuse. Eight of the 12 9 month olds, on at least one trick trial, either reacted with mild puzzlement, a score of 4, or subsequently questioned the toy they found, a score of 4. Finally, the responses of the 12 month olds was both intermediate and more variable. Thus, looking at infants' reactions to the trick in terms of our rating scheme led to results which generally conform to Piaget's account of the development of the object concept.

Saal (1975) set out to examine the phenomena I have just presented in two ways. On the one hand, she chose to extend the age range, studying 6 month olds as well as 9, 12, and 18 month olds. On the other hand, she varied the nature of the object change. In the LeCompte and Gratch study, toy 1 and toy 2 were different toys. Saal replicated this condition, using a small drab plastic horse and a relatively large colored block which contained a bell. The other condition involved a change in the color of the block. She had a number of hypotheses, one of the more entertaining being the possibility that the gross change would be interpreted as an object exchange whereas the color

change would be interpreted as a transformation of the same object. I'll not elaborate her various hypotheses because to her disappointment the two change conditions did not produce differences in responses to the tricks.

Table 4 presents the results of her study, where the two toy conditions

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Insert Table 4 about here

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are collapsed. There are two interesting trends, both statistically significant. If you look at the puzzlement heading and the third column under it, the mean of the two tricks, you'll note that the scores for the 6 and 9 month olds are about 3 and these scores differ from the scores of the 12 and 18 month olds. In other words, only the 12 and 18 month olds tended to react to the trick with puzzlement when they first looked at the toy. On the other hand, looking at the comparable mean column under the instrumental reaction heading reveals a different picture. Only the six month olds tended to not show signs of distress over the new toy. The six month olds tended to have scores of 3 or less whereas the 9 month olds were more likely to get scores of 4, behaving much like the 12 month olds. In other words, once the 9 month olds took the toy in hand, they often were distressed by the change. But looking alone did not provoke the distress. This is an intriguing result, one much like that reported by Schaffer, Greenwood, and Parry (1972) in another context. In each session of a longitudinal study, those investigators repeatedly gave the infant the opportunity to see and handle an object. Then the infant was given a different colored copy of the toy. There was a substantial change in the infants' reactions at around ages 8 and 9 months. At younger ages, the infants would stare longer at the new toy than the old toy, but they would quickly snatch it up, as if the novel object were more interesting than the old one. At 8 and 9 months, the infants would stare even longer at the

new toy than they did at younger ages, but more importantly, they would reach far more slowly for it. Thus, the sudden appearance of a new toy led them to be wary, they gave the toy a different meaning than did the younger infants.

Saal discovered two other things I'd like to mention. She tricked a few babies at each age on the very first trial of the game and got comparable age trends. In other words, the reactions I have described do not appear to be a function of the particular sequence of trials we used in the LeCompte and Gratch (1972) and Saal studies. The infants appear to come to the game with a set, a scheme, that determines how they will react to the trick. Second, at the end of her trial series, Saal played one last trick with some of the babies. She hid a toy and the infants found nothing. The infants' reactions to finding nothing were comparable to their reactions to finding a different toy.

I have now ended my trip and return to my original metaphor of the jungle. I have repeatedly emphasized the phenomenal because I feel clear at that level and I think the virtue of Piaget's approach to the problem of object knowledge lies in important part in what phenomena he chose to study and how he studied them.

Piaget studied the problem in a direct way. What the examiner does, what the infant does, what the situation is, all tend to be in plain view. The events are not obscured from the subject, the examiner, or the observer by elaborate machinery or complicated indices of the events.

Piaget sensed that the task of the infant is not so much that of object recognition as that of keeping track of objects. We seldom get a clear view of things, either because we or they are on the move. While some forms stay put, are the walls and furniture of our "boxes," something usually is in front or beside or behind them. Other forms, particularly animate ones, are on the move. The problem for the infant is one of keeping track of such things, in-sight, out-of-sight, in space-time. The problem for the infant, and for us,

is to know whether what is seen how, was seen awhile ago, will be seen soon is the same or different, is the same or similar.

So much for clarity. While the phenomena I have discussed are orderly, their meaning remains to be determined. I'll close by presenting some provisional thoughts on how to interpret what I have presented to you.

I would like to think that I have given you reason to believe in the viability of Piaget's hypothesis that somewhere between 6 and 9 months infants come to a new level of awareness of objects--the successive appearances in time and space of objects are seen as connected albeit diffusely. The LeCompte and Gratch (1972) and Saal (1975) studies show that 9 month olds have a real but confused sense that the specific toy that disappears in one place should reappear in that place. The $A\overline{B}$ studies suggest that the sense of connectedness also involves spatial confusions. The Schaffer, Greenwood, and Parry study (1972) seems to support this generalization. At 8 and 9 months of age, infants treated the suddenly appearing new object warily, implying that they had a sense of what was to be expected and it was violated. But what does Piaget's hypothesis really entail and isn't there strong contrary evidence provided by Bower's (1974) many studies of much younger infants?

As to the contrary evidence, I don't think it is compelling. I had hoped to come before you to talk about a study by a student, Muriel Meicler. She intends to examine the reaction of 5 and 6 month old infants to a trick in a visual tracking situation much like that employed by Bower and his group. Unfortunately, she has run into an unspeakable apparatus problem. Therefore, I have no direct evidence that infants of that age and younger do not know about the permanence of objects when they simply watch objects track behind a screen. However, I can say that there is reason to doubt the evidence that young infants do know about the permanence of objects on a visual level and somehow lose it when they have to coordinate vision and touch. In particular,

one major study, that of Bower, Broughton, and Moore (1971), had major procedural flaws which I have detailed elsewhere (in press). Gardner (1971) also reported that young infants will be distressed and will search for the missing object when they are tricked in a tracking situation. Her study does not suffer from the procedural flaws of the prior study, but her observations were not made in such a manner that one can demonstrate that the infants were not simply reacting to, in Piaget's terms, "picture changes."

The issue is an important one and has to be settled by direct investigation. Further the contraversy serves to focus attention on the role of action. Smillie (1972) has ably pointed out that the Piaget of the infancy books certainly underestimated the amount of event structure that very young infants are able to attend to visually. But even if we grant the possibility that Piaget is right in asserting that infants move from a "pictorial" to a pre-object conceptual to an object conceptual level of awareness, is the elaboration and coordination of action schemes the mechanism responsible for this course of development? Clearly action has something to do with the course of development. The great increase in infants' sensorimotor resourcefulness that appears around 6 to 9 months of age clearly puts them in a position to know very different things about objects than they could have known in prior months. But the key issue is whether the actions are constituitive of knowledge, as Piaget would argue, or whether "The acts of picking up and reaching reveal certain facts about objects; they do not create them." (Gibson, 1966, p. 274).

I have no answers. The study by Evans (1974) of the $A\overline{B}$ error, in which he compared observing the toy disappear and reappear at A with finding it at A, clearly suggests that Piaget is wrong in a limited sense. The specific act of finding at A does not appear to determine the error. Rather noting the appearance-disappearance sequence seems to mark A as the special place. On the other

hand, Piaget seems to be trying to use the theme of action to explain something larger than particular objects and places. He talks of these as specifics, figurative matters, matters highly determined by particular sensory displays. Piaget is trying to use the notion of action to account for how we order particularities, how we get at generalities, initially of a sensorimotor sort--the object in an ordered context--, ultimately of a logical sort. I presently cannot do more than to say that Piaget, for all of his vagaries of at least expression, serves us well by keeping our attention focussed on this key issue--the developmental relation between the particular and the general.

I shall close by commenting upon what I see as a salutory trend, sparked by Piaget's focus on levels of object awareness. Piaget came to focus on the particular paradigm of playing hiding games with infants from a rich context of observations of infants in many settings. My own work, and that of others, by sticking very closely to the hiding game paradigm, contains the seeds of creating a world of its own, falsely haloed by the phrase object concepts. Thus, I would like to note the efforts of Keith Moore (1974) and Kessen and Nelson (1974). They have begun to map out the kinds of placements of animate and inanimate objects in time-space that infants are exposed to at different times of life. Such an ecological mapping is the necessary counterpart to the attempt to map out the growth of the mind and contains the basis for reconciling the wise but conflicting positions of constructionists such as Piaget and realists like E.J. and J.J. Gibson.

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Table 1

Relation of Delay Length and Length of Run of B Trials in Which S Searches at A: Number of Ss

| | Length of Run (Begins with first B trial) | | | | | | |
|---|---|---|---|---|---|---|---|
| Delay | 0 | 1 | 2 | 3 | 4 | ≥5 | T |
| 0 Seconds | 11 | 0 | 0 | 0 | 0 | 1 | 12 |
| 1 Seconds | 4 | 1 | 3 | 0 | 0 | 4 | 12 |
| 3 Seconds | 3 | 3 | 1 | 0 | 0 | 5 | 12 |
| 7 Seconds | 3 | 1 | 0 | 4 | 1 | 3 | 12 |
| Total Ss | 21 | 5 | 4 | 4 | 1 | 13 | 48 |

TABLE 2

LEVELS OF PUZZLEMENT SCALE

| | |
|---|---|
| 6 - Surprise: | A stunned look appears on the subject's face. Eyes widen, eyebrows move up, face relaxes, and mouth falls open. These facial expressions are coupled with such behaviors as a freezing of the body, hand stopping in mid air, and sudden vocalization changes. |
| 5 - Definite puzzlement: | A strong persistent frown appears on the subject's face. The eyebrows knit, the face sobers up, a tightness appears in the mouth and cheeks. The body and the hand may also respond with a momentary freeze, but this would not be as intense and prolonged as in the case of surprise. |
| 4 - Mild puzzlement: | A weaker, and more fleeting puzzlement. A very slight frown appears on the subject's face and a sobering occurs. There is no freezing of the body or the hand and the intensity of stare at the toy is lower. (This category has a sub-category which is rated when subject shows no frowning but a vague, confused, baffled look, with a loosening of face rather than a sobering up.) |
| 3 - Noticing toy only: | Subject looks at toy carefully with a long, decided stare. He may show pleasure or displeasure, but no indication of bafflement, puzzlement, or surprise. |
| 2 - Recognition: | Subject looks at toy with a short stare of recognition. He spends some time to recognize what is in the box, but not as long as in scale point 3. |
| 1 - Automatic look: | Subject takes a very quick, casual, automatic look at the toy. He either hardly sees the toy before he takes it out of the box, or does not even bother to look until he has it out of the box. |

TABLE 3

LEVELS OF INSTRUMENTAL REACTION

| | |
|---|---|
| 8 - Solving the puzzle: | Subject actually finds the knob and works it to make toys appear and disappear. |
| 7 - Focus on the mechanism of the game: | Subject takes box, and turns it around in a variety of ways, and systematically searches for a mechanism. |
| 6 - Focus on toy box and experimenter: | Subject includes both the box and the experimenter in his attempts to determine what has happened. He searches in the box persistently and looks at the experimenter repeatedly in a questioning and suspicious manner. |
| 5 - Focus on lost toy: | Subject searches in and around the box, in washcloth, on the floor for the missing toy. He may look at the experimenter, but this is either a sociable glance, or a complaining look, as opposed to a questioning, suspicious one, as in scale point 6. |
| 4 - Questioning the toy found: | Subject acts as if he cannot accept or reject the toy he finds in the box. He persistently picks up and puts down the toy, questioning its presence in the box. He may look at the toy and the experimenter in bafflement, and treat the toy as if it has some "eerie" quality. |
| 3 - Examining the toy: | Subject recognizes he is faced with a different toy, add actively explores the properties of this thing. |
| 2 - Appropriate treatment of the toy: | Subject treats the toy in a manner appropriate for that toy. If he likes the toy, he plays with it; if he doesn't like it, he refuses to take it or gives it to the experimenter, or throws it on the floor. |
| 1 - Stereotyped play with the toy: | Subject takes toy and either mouths it or bangs it, or he simply holds the toy in his hand doing nothing with it. |

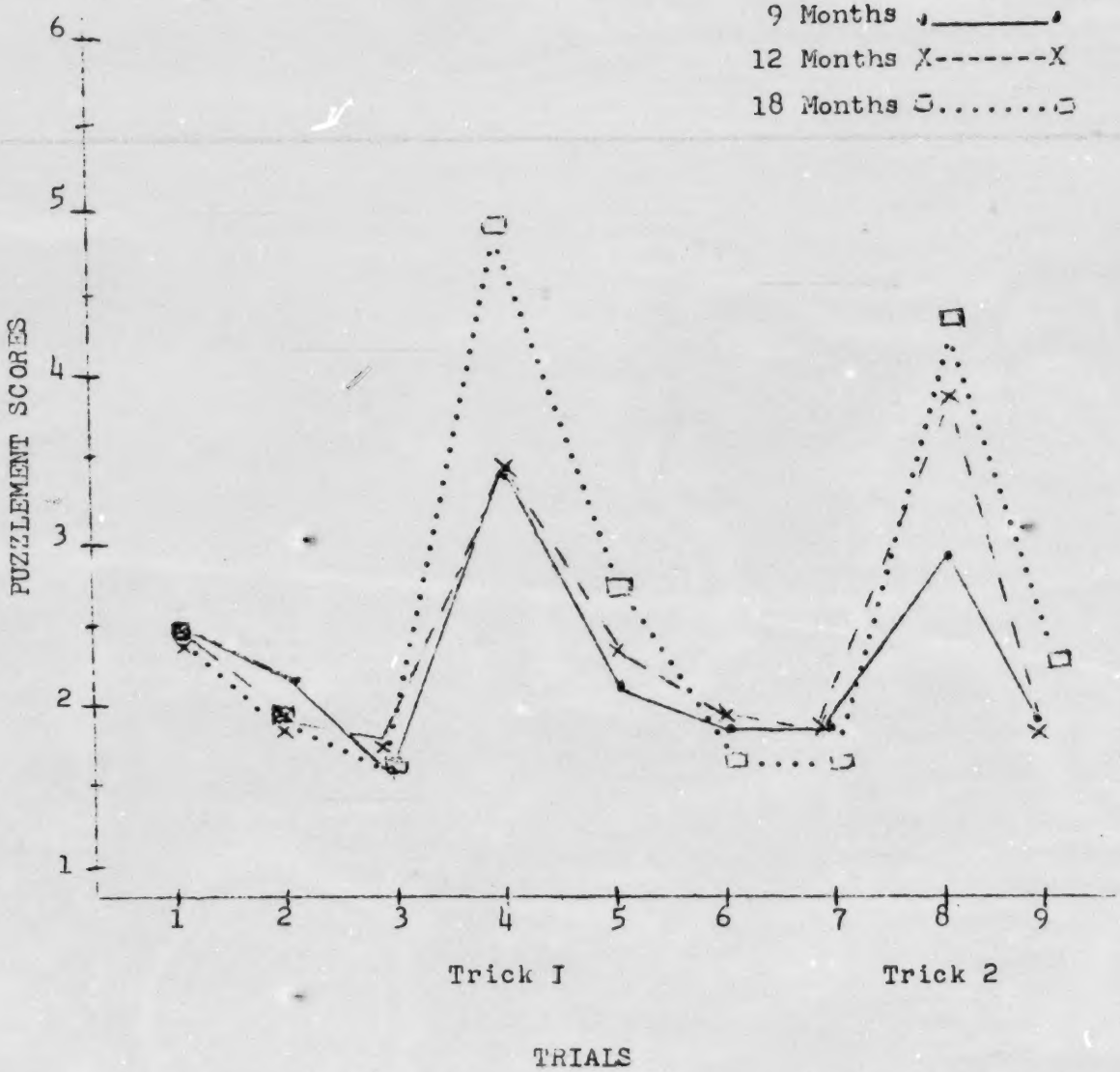


Fig. 1 - Mean Puzzlement Scores Of The Age Groups On Each Trial

TABLE 4

MEAN FUZZIEMENT AND INSTRUMENTAL REACTIONS

| AGE | FUZZIEMENT | | | INSTRUMENTAL | | |
|---|---|---|---|---|---|---|
| (months) | Trick 1 | Trick 2 | Mean | Trick 1 | Trick 2 | Mean |
| 6 | 3.00 | 2.83 | 2.92 | 2.67 | 2.50 | 2.58 |
| 9 | 3.17 | 2.83 | 3.00 | 3.42 | 3.33 | 3.37 |
| 12 | 3.83 | 3.92 | 3.88 | 3.58 | 3.42 | 3.50 |
| 18 | 4.83 | 4.83 | 4.83 | 4.58 | 4.33 | 4.46 |